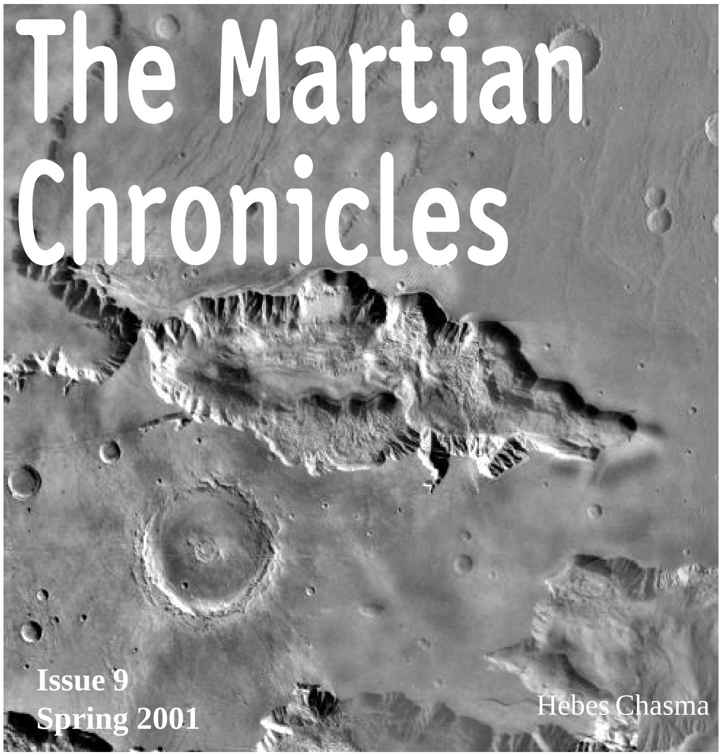
http://chapters.marssociety.org/youth/

The Martian Chronicles



Issue 9
Spring 2001

Hebes Chasma

Contents

Dear Reader,

The Martian Chronicles aim to excite youth about the exploration and near-future human settlement of Mars.

Please distribute The Chronicles freely!!! To be added to the announcement list, or to receive paper copies for distribution, contact MarsYouth@mit.edu .

This newsletter is produced by the **Mars Society Youth Chapter** and the **MIT Mars Society Chapter**.

Send us your submissions to MarsYouth@mit.edu .

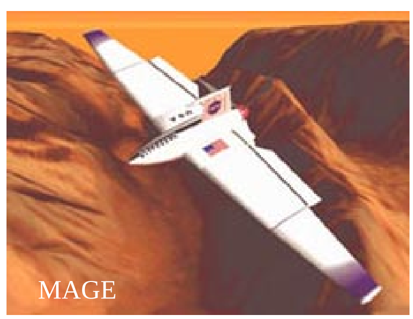
Enjoy *The Martian Chronicles!*

Margarita Marinova, Editor

Mars News

Margarita Marinova

Recently NASA put out a request for teams to submit proposals to study various Mars mission concepts which could be flown as part of the Mars Scout missions, starting in 2007. The interest in these missions was clearly evident as 43 teams submitted proposals. The ideas ranges from exploring the polar caps, to sending missions which would fly through the atmosphere for prolonged periods of time, to low-cost Mars sample return missions. A significant number of the proposals suggested deploying balloons or planes on Mars, showing the great interest in aerial observations of Mars.



MAGE

Of the 43 submitted proposals, 10 were funded for further study. Some of these are:

* **KittyHawk:** Professor Wendy Calvin, University of Nevada- Reno. A mission involving three gliders would explore the composition and stratigraphy of the walls of Valles Marineris in ways not possible for orbiters and landers.

* **Urey:** Dr. Jeff Plescia, U.S. Geological Survey, Flagstaff, AZ. A surface rover would allow the absolute ages of geological materials to be remotely determined for the first time on any planet.

* **Pascal:** Dr. Rob Haberle, NASA's Ames Research Center, Moffett Field, CA. A network of 24 weather stations on the martian surface would provide more than two years of continuous monitoring of humidity, pressure and temperature and other measurements.

* **The Naiades:** Dr. Bob Grimm, Blackhawk GeoServices, Golden, CO. Four landers will search for subsurface liquid water using a novel low-frequency sounding method.

* **CryoScout:** Dr. Frank Carsey, JPL. This mission, designed to use heated water jets to descend through martian polar ice caps, could potentially probe to depths of tens to hundreds of meters while measuring composition and searching for organic compounds.

The Martian Chronicles are

Produced by: **Mars Society Youth Chapter**
Mars Society MIT Chapter
Distribution funded by:
Massachusetts Institute of Technology

MIT Massachusetts Institute of Technology

The Mars Society

Word Search Puzzle

Julie Edwards

Around Hellas, Mars

Find the words from this list in the puzzle. Words can be right to left, left to right, top to bottom, bottom to top, or diagonal, and can overlap other words. Category words are included. The word MARS is hidden at least 5 times.

PLANITIA
- **HELLAS**

PLANUM
- **MALEA**

PATERA
- **AMPHITRITES**

MONTES
- **HELLESPONTUS**

VALLIS
- **DAO**
- **HARMAKHIS**

CRATER
- **BARNARD**
- **GILBERT**
- **GLEDHILL**
- **HUXLEY**
- **MITCHEL**
- **NIESTEN**
- **RABE**
- **REDI**
- **SCHAEBERLE**
- **SPALLANZANI**
- **TERBY**

THOLUS
- **AUSTRALIS**

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          S A L L E H
      P P S M O N T E S A
  H E L L E S P O N T U S R O U B
  N D A A H E H A R M A K H I S A
S L N R N S L I A L S R A M C I R M
S U I E I I M T H O L U S H M L N A
M C E T T L I R R R T A A S A L A R
O R S A I A T I U E N E N S M A R S
D A T P A R C T H E B A R Z R V D E
R T E L M T H E L E R L O B A A A A
  E N S A S E S R M E A I A Y N M
  R R S R U L L I H D E L G A R I
        S A E L A M I O U N
          H U X L E Y
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Cool Links

Margarita Marinova

1) http://www.pbs.org/lifebeyondearth/ - Lots of information about Life Beyond the Earth - the planets, moons, terraforming Mars - and many other related topics. From PBS.

LIFE BEYOND EARTH

MISSION 2004 The Search for Life on Mars

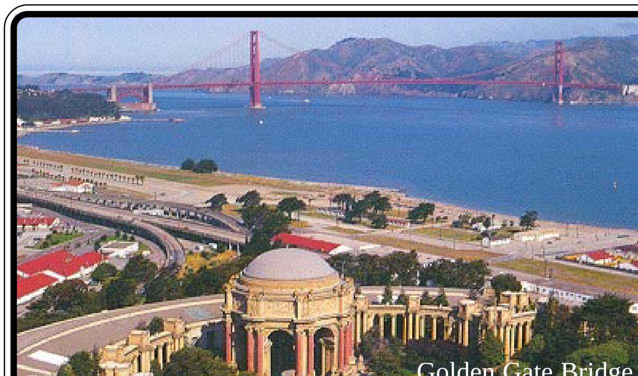
2) http://mission2004.org - Contains the entire Mission 2004: The Search for Life on Mars project information (see pg. 7 of this issue).

3) http://nai.arc.nasa.gov/ - NASA Astrobiology Institute - Links to Astrobiology news, educational materials, learn more about the various member institutions and members of the Institute, and other great links.

NASA ASTROBIOLOGY INSTITUTE

Canadian Space Agency
Agence spatiale canadienne
CSA ASC

4) http://www.space.gc.ca/home/index.asp - Learn about the Canadian Space Agency and the various projects that they are involved in! Learn about the building of the Canadarm2 which is used to build the International Space Station.



Golden Gate Bridge

4th Annual Mars Society Convention

August 23-26, 2001

Stanford University, California

To register, visit http://www.marssociety.org

Reserve your dorm room today!

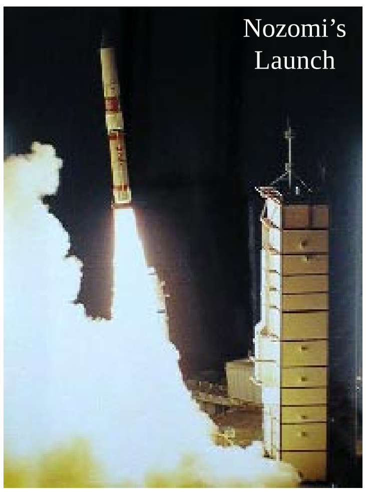
The Nozomi Mission to Mars

Anthony M. Schilling

The Japanese Institute of Space and Astronautical Science (ISAS) launched Nozomi/Planet B towards Mars on July 4th, 1998 from the Kagoshima Space Center. After launch, the $80 million dollar, 535 kg (1,177lb) Planet B probe was renamed “Nozomi” (Hope). Japan became the third country, after the US and Russia, to launch a Mars probe.

Saving the Mission

Nozomi’s original trajectory involved orbiting the Earth for 4 months, then 2 lunar swingbys and a powered Earth swingby. The December 20, 1998 powered Earth swingby was to put Nozomi on a transfer orbit with a scheduled arrival at Mars for October 11, 1999. Unfortunately, a thruster valve malfunction during the Earth swingby put the spacecraft into an incorrect trajectory. To correct the error, the Mission Control team decided on a second firing, which placed Nozomi back on a trajectory toward Mars.


Nozomi’s Launch

As a result of the second maneuver, Nozomi no longer had enough fuel to place itself into orbit around Mars. The mission analysis team found an alternative trajectory to would save the mission. Nozomi would perform two more swingbys of Earth - in December 2002 and another in June 2003. This low fuel consumption trajectory would put the spacecraft into orbit around Mars during January 2004. Upon arrival, Nozomi’s orbit will range from a low of 96 miles to 27,000 miles.

The mission science

Nozomi’s 2 year primary mission is to investigate the motion and structure of the upper atmosphere and ionosphere of Mars. The probe will also study the interaction of the atmosphere, ionosphere, and solar wind. There are 14 experiments on the Nozomi from 5 different countries, including a NASA neutral mass spectrometer. Other countries contributing experiments include Canada, Germany, and Sweden.

NASA’s Neutral Mass Spectrometer (NMS) will study the vertical and horizontal density variations of the major neutral constituents in the upper atmosphere of Mars.


Planet-B/Nozomi getting ready for launch


Nozomi

The measurements will determine the existing dynamic, chemical, and thermal state. The highly elliptical orbit will allow data to be taken in the low altitude atmospheres and ionosphere as well as the solar wind interaction regions.

Nozomi’s NMS results will be compared to results from the 1960’s Pioneer Venus mission, which used a similar type of instrument.

Other instruments onboard include a Mars Imaging Camera from Kobe University and a Mars Dust Counter which will search for a dust ring along the orbit of Phobos. Nozomi’s orbit is designed to permit very close passes of Phobos and Deimos to observe the shape and surface in detail. A Thermal Plasma Analyzer from Canada will investigate the components, structure, temperature, and plasma waves of the ionosphere. Other instruments from Japan will study the ionosphere, magnetic field, and atmosphere of Mars.

Current status

Despite its initial fuel problem, Nozomi has recovered well and is midway through its long journey. Nozomi is providing measurements of the interplanetary medium as it travels towards Mars. The spacecraft and its instruments are in excellent health, and they are expected to enter orbit around Mars during January 2004. MC

Meet the Scientist

Dr. Jack Farmer

Exobiologist

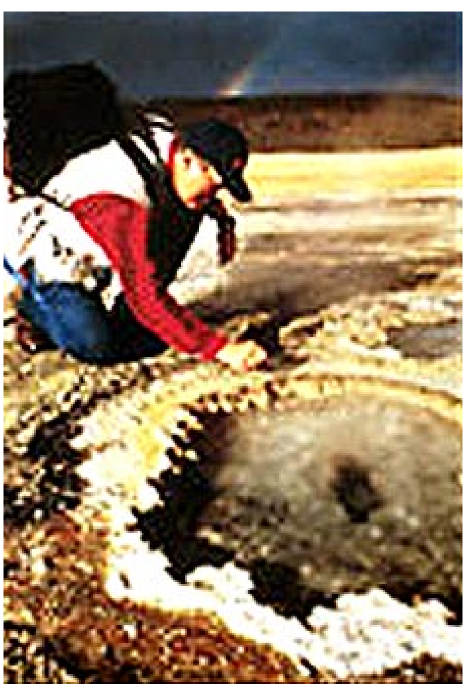
Arizona State University, Dept. of Geology

Veronica Ann Zabala

Q: What are your areas of research?
A: Microbial biosedimentology and paleontology, early biosphere evolution, astrobiology.

Q: How did you choose your current research?
A: I specialized in paleobiology and sedimentology in graduate school. I began to work with microbial ecosystems and to apply this knowledge to problems of early biosphere development during the early 80's when I was at UCLA. I moved into applications to Mars exploration in the early-90's, after beginning work as a research scientist at NASA Ames Research Center.

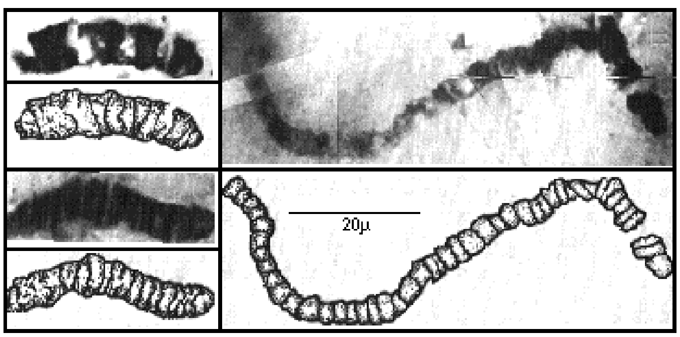
Q: How is your research related to studying Mars?
A: I have been interested in how to apply our knowledge of early biosphere evolution based on the fossil record of Earth to strategic planning for Mars exploration. We now have a record of life on Earth that goes back to the oldest rocks available for study. However, although life seems to exist about anywhere liquid water is available, preservation of fossil biosignatures is quite narrowly limited to only certain types of aqueous environments and their deposits. My research has been aimed at understanding the factors that control biosignature preservation and how that knowledge can be translated into an exploration strategy for Mars. When I began this research in the mid-90's, only a few of us had actively thought about such things, and essentially no one had considered the implications for strategic planning. Out of that work came a new subdiscipline of astrobiology which I call exopaleontology. The past half dozen years have been quite productive for Mars exopaleontology with the application of basic principles to developing exploration strategies for Mars. Interest in the field was consolidated with the report of putative biosignatures in martian meteorite, ALH 84001 (still controversial!). With that development, the Mars Program also became more responsive. In practical terms, the exploration for past life is now a primary driver in the robotic program. I have had numerous opportunities the past 6 years to provide input into Mars mission planning through my involvement with numerous NASA mission planning activities.



Dr. Jack Farmer

Q: You are currently looking for future Mars landing sites: how is a landing site selected and what are the mission priorities?
A: The selection of landing sites is a crucial step for implementing the strategy for Mars astrobiology. If we land in the wrong place, we will not be able to access the most favorable past or present environments for life. The search involves the detection of sites where two things coincided: 1) conditions for persistence of life and 2) conditions for the capture and preservation of biosignatures. We know that the most fundamental requirement for life is liquid water, so the search for sites is first and foremost driven by the search for past or present water. But within aqueous environments, we also know that special conditions are required for the preservation of biosignatures. The two most important geological environments for biosignature preservation are 1) sites of rapid mineral precipitation (e.g. mineralizing springs, evaporative lakes, etc.) and 2) low energy, anoxic lake environments where fine-grained, clay-rich sediments (e.g. shales, water-lain volcanic ash, etc.) were deposited. Virtually all fossil microbial biosignatures found in the Precambrian record on Earth are found in these settings. In concert with the above requirements, the goal in our site selection

research has been to locate and characterize the places on Mars where liquid water was present on the surface for prolonged periods and where geological environments were also favorable for the capture and prolonged preservation of fossil biosignatures. We approach the first step (question of liquid water) primarily through the identification and study of geomorphic features that represent surface modification (erosion or deposition) by flowing or standing bodies of water. This involves careful analysis and interpretation of Viking and, more recently, Mars Observer Camera (MOC) orbital imaging of the martian surface. The question of favorable geological conditions (environments) for biosignature preservation is more involved and requires the detection of certain classes of aqueously-formed minerals that are precise paleoenvironmental indicators. The Thermal Emission Spectrometer (TES) which is presently in orbit around Mars is providing a first global look at that type of information. Initial results suggest that certain sites where the geomorphology indicates that water was once present, were also sites of active aqueous mineral precipitation (specifically, specular hematite). But higher resolution mapping will be needed to really identify and map the distribution of other, potentially more important minerals like carbonates and sulfates. This will be possible with the THEMIS instrument on the Mars Odyssey orbiter.



Q: What missions have you been involved with?
A: I was involved with landing site selection for Mars Pathfinder and the 2003 mission (I am a member of the NASA's 2003 Landing Site Steering Committee). I was also a member of the science definition teams for the Mars 2001 and 2005 missions. Over the past year, I also participated in the recent re-vamping of the Mars Program architecture as Chair of the Life Subgroup for NASA's Mars Exploration Program (now Payload) Advisory Group. Finally, I am a member of the Space Sciences Advisory Committee which advises NASA on how to develop and implement the agency's strategic plan to explore the Solar System.

Q: How do the NASA cutbacks affect your research? What solutions do you have for the future of Mars Exploration?
A: Clearly, research requires funding. With cut-backs, the process always suffers. Perhaps the most limiting thing I have faced is overly cost constrained missions which require cut-backs in science payload and mission scope. This has been a persistent problem in the Mars Program since I have


Stromatolites

been involved, and has occurred for a variety of reasons. I think everyone shares the goal to establish a stable funding environment where full implementation of what are now very well-established science goals, will be assured. Otherwise the ongoing investment in research and strategic planning becomes an exercise in futility where we are called upon to "re-invent the wheel" every few years. I would say that the long-term solutions lie in Congress and the agency being willing to make a long-term commitment to implement the well-defined Program and science strategy by stabilizing the funding environment so that the missions are protected against erosion. I also think we need to continue to protect Research and Data Analysis Programs against cut-backs, and in fact find productive ways to expand those programs to expand the opportunities for more scientists, particularly those just being trained, to become involved in missions.

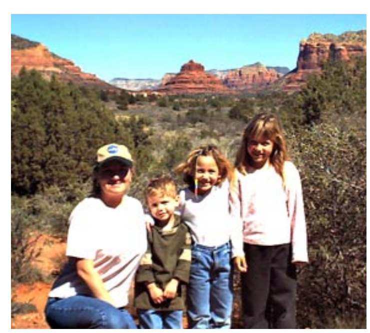
Q:Where can we get more information about what you do?
A: I would recommend ASU's Astrobiology Program website (http://astrobiology.asu.edu/) which has a lot of links to other interesting sites.

Q: If you were among the first to go to Mars, what three items would you bring along with you?
A: A rock hammer, hand lens and a four-wheel drive mini-van!

MC

~*~*~*~*~*~*~*~*~*~*~*~*~

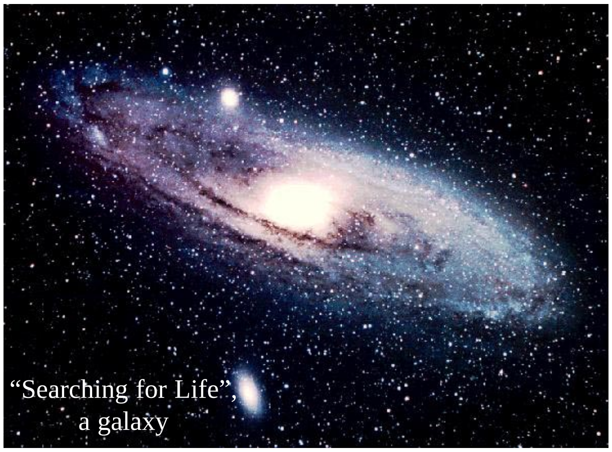
Veronica Ann Zabala is an undergraduate student currently attending Arizona State University majoring in Geology. Veronica is the President of the Arizona State University and Phoenix Chapters of the Mars Society. She is currently analyzing the aeolian dynamics of Mars from interpretation of data from Mariner 9, Viking Orbiter and Mars Global Surveyor (MOC) images. Along with atmospheric circulation models, the determination of the aeolian history on Mars can be investigated to determine surface-atmosphere interactions and aid in the selection of future landing sites on Mars. GeoBum@prodigy.net



Searching for Life on Other Planets
Part I: Defining Life

Elizabeth Tay

For centuries mankind has been scouring the skies in search of extraterrestrial life. But what is "life"? How do we know when we have found it? The Oxford Dictionary defines life as the "capacity for growth, functional activity, and continuous change until death". But scientists fear that similar criteria for identifying life may not apply on other planets.


"Searching for Life", a galaxy

The first sign of life elsewhere will probably not be as obvious as little green men or purple eighty-legged animals. In fact, it is likely to be microscopic and maybe not at all similar to life on Earth. So, where and how should we search?

Criteria for Life.

Before we begin our search, we have to work out what it is exactly that we are searching for. The first criterion for life (as we know it) is energy. Life requires energy to perform life-sustaining processes such as respiration. This energy can be in practically any form - geothermal heat, tidal energy, chemical energy, or sunlight. This does not appreciably narrow down the places where we should look.

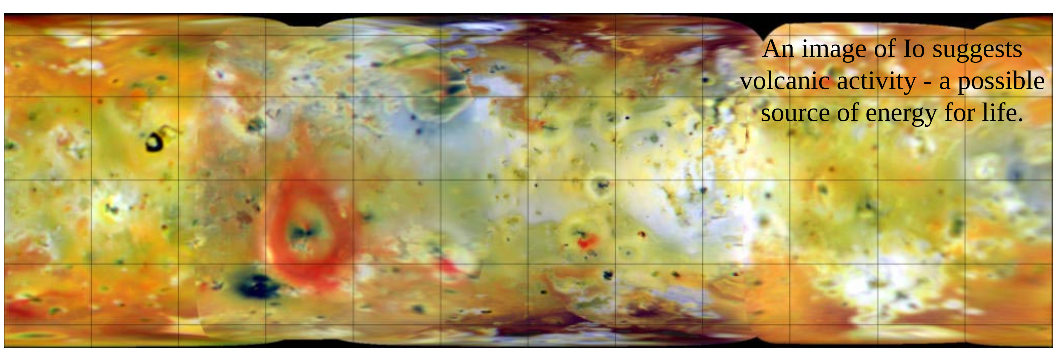
The National Aeronautics and Space Administration (NASA) believes that the secret to life is liquid water, which translates into location. "Life cannot survive in hot conditions like on our sun. Life needs to be where it is not too hot and not too cold, and at a temperature at which liquid water can exist." Thus, it is important to pay special attention to places which can support liquid water, either at the surface or subsurface of the celestial body.

The chemicals present in the atmosphere of a planet or a moon are important indicators of the presence of life. As per James Lovelock's Gaia hypothesis, on any planet with thriving life, that life will have control over the atmospheric composition. This is because life will alter its surroundings in order to optimize them. For Earth-like life, this optimization takes the atmosphere far from the equilibrium state to a composition which cannot be achieved without the presence of life. Therefore, certain ratios of carbon dioxide, water vapor, and oxygen in the atmosphere are possible indicators that the astral body hosts life. While finding a non-equilibrium atmosphere is a sure sign of life, this is not a necessary condition. Oxygen appeared on Earth only about 500 million years ago, but we know that a whole world of bacteria thrived long before that, and life originated over 3.5 billion years ago.

Location, location, location

At 149.6 million kilometres from the Sun, Earth is pretty much in the perfect spot. As a result of its location and its significant greenhouse effect (CO_2 and water vapour in the atmosphere), Earth maintains an average temperature of 15 degrees Celsius – an ideal temperature for life to thrive.

Mars is the second most favourable place for life, and human habitation. This is due to its relative similarity to Earth – both are solid planets and are within the range of distances from the Sun which allow for liquid water conditions (the habitable zone). Similar to Earth, Mars also contains the elements required for Earth-like life - C, H, N, O, P, S, and water. Currently, Mars is too cold and has too thin an atmosphere to support liquid water on its surface or in the near subsurface. However, Mars is believed to have been very much like the Earth when the planets formed - and life on Earth arose. The reason behind the significant differences between the two planets today is thought to be Mars' lack of plate tectonics. The carbon dioxide responsible for the greenhouse warming would have reacted with water to form carbonate rocks, but could not be recycled back into the atmosphere; therefore, Mars could not maintain a significant greenhouse warming.


An image of Io suggests volcanic activity - a possible source of energy for life.

Other celestial bodies with good prospects of hosting life (as we know it) include four of Jupiter's moons - Europa, Enceladus, Titan and Io.

…Next: The search for life supporting planets in the search for extraterrestrial life…

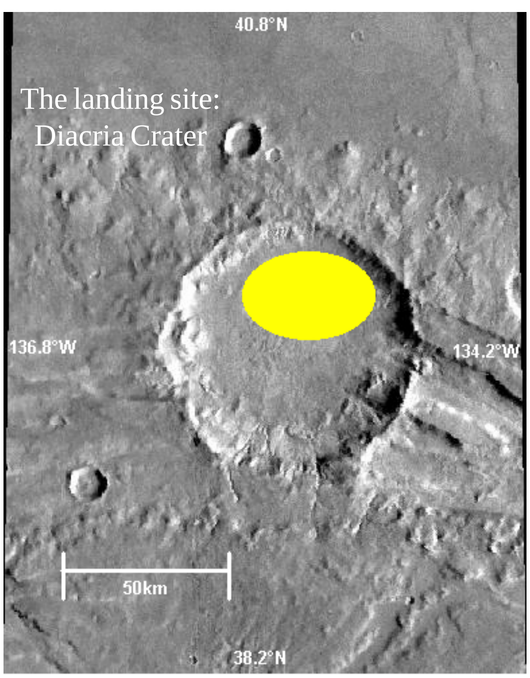
MC

Is there life on Mars? How would you begin to answer this question?

In the Fall of 2000, Mission 2004: The Search for Life On Mars was a new class offered to freshman as part of an Institute-wide initiative to expand the horizons of MIT undergraduate education. While most first year subjects deal with the typical "problem set" and lecture type atmosphere, Mission 2004, taught by Professor Kip Hodges, provided a unique opportunity to experience cross-disciplinary problem solving in a collaborative learning environment. The students were assigned the following task: Develop a viable mission plan for the exploration of Mars with the aim of finding evidence for the present or past existence of life.

In teams, the students tackled various technical, scientific, and political issues that would affect a Mars mission. Several questions were extensively discussed and debated. For example, how do we define life? We decided on five criteria for life, based on the energy properties of living systems rather the than chemical properties.

The following five basic charactertics were used as the definition of life for this mission design: (1) shows evidence of growth and replication; (2) shows evidence of purposeful energy transfer; (3) responds to stimuli; (4) acts in such a way as to ensure self-preservation; and (5) is significantly different from the surrounding environment.

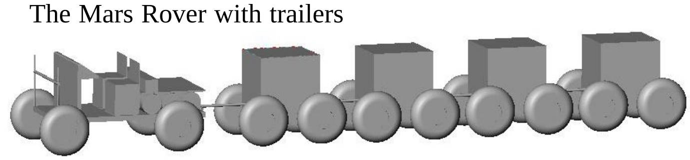


The landing site: Diacria Crater

After the definition of life was established and it was decided that the mission should be manned, the details of the mission architecture began to fall into place. But still numerous questions remained - how will the public react and how much would they be willing to pay for a mission in search of life on Mars? The Mission 2004 team looked into public relations through advertising and public funding. A mission budget based on the percentage that NASA gave to the Apollo program in the 1960's and other Mars missions was estimated to be $140 billion over 20 years.

How do we get to Mars? The extensive mission payload required advanced propulsion systems to be adopted, separating experimental equipment and the human crew. Surface transportation (rovers) were developed to handle the experimental packages. Incorporated into all structures were life support methods and communication systems. Life detecting methods included geological surveys, spectroscopic analysis, organic analysis, and biological experiments. A timeline for the mission, which included a breakdown of research, manufacturing, launch windows, travel/stay time, was developed. This comprehensive plan embodies the semester of work entitled Mission 2004: The Search for Life on Mars. The plan was presented formally to the MIT community and two leading NASA scientists - Dr. Jack Farmer and Dr. Jim Garvin. The Mission 2004 presentation and multi-media website, containing further information, can be viewed at: http://web.mit.edu/12.000/www/home.html MC

The Mars Rover with trailers



Associate Editor Wanted

Would you like to be an Associate Editor for The Martian Chronicles?

We are currently looking for a motivated and dedicated individual with a strong interest and/or experience who will be responsible for the collection of articles, ensuring the quality of these articles, and completing the layout for the issue. While others will help with these tasks, the timely release and distribution of The Chronicles will be the responsibility of the Associate Editor.

If interested, please send a short description of why you are interested in the position and any past experience to MarsYouth@mit.edu .

Donate to The Martian Chronicles

We currently distribute over 400 printed copies of The Chronicles to countries all over the world, and our reach is expanding! We need your help to continue the production of the Martian Chronicles and to make it available to more young people all over the globe!

We would greatly appreciate any help with the distribution of the Chronicles - this can be in the form for monetary donation, or through printing of the issues for no cost or a very low cost. Large sponsorships will receive advertising space in The Chronicles.

To Donate, please contact MarsYouth@mit.edu, or you can send checks made payable to MIT to

Mars Society - The Martian Chronicles
77 Mass Ave., W20-401
Cambridge, MA 02139

Mars Q&A

Q: We use salt here on Earth to melt ice on our sidewalks and streets. Would it be possible to use a similar technique to melt Mars' polar ice caps? (Jennifer)
A: Adding salt to water lowers its freezing point. This would be true on Mars as well as on Earth. The lowest that a salt salution can lower the freezing point is what is called the eutectic point. For ordinary salt (Sodium chloride) the eutectic point is about -20C (about 0 F). Since the temperature on Mars is well below this (average is -60C), this salt will not allow melting on Mars.

Q: How long would it take to make a phone call from Mars to Earth? (Ben Bern)
A: It takes a signal 12-20 minutes to travel each way when Mars is on the same side of the Sun as us. Phone calls as we know them cannot be made to Mars with this kind of delay.

Greening Mars
(James Graham, Kandis Elliot)

Q: When man begins the process of terraforming Mars there will most likely be protestors that want to keep Mars as it is. How will we cope with that? (Brett)
A: When terraforming Mars is seriously proposed by martian settlers, debate will rage all over both planets. Terraforming will probably still continue by the settlers who will benefit from it the most. Some compromises can be made, such trying to limit the thickness of the atmosphere, thereby keeping areas at high elevations mostly pristine. But such limits are not a solution, even if we really did have the technological ability to enforce them. In the end it will be the first generations of Martians who will decided what happens to Mars. And while terraforming Mars will certainly change the planet significantly, the many years that terraforming will take will give much time for the current beautiful, but lifeless, Mars to be explored through the eyes of artists and scientists.

The Mars Society is an international non-profit organization committed to furthering the goal of robotic exploration and human settlement of the Red Planet. www.marssociety.org

The Mars Society Youth Chapter was created to provide Youth the opportunity to become more involved in the Mars Society and other Mars-related issues, and to provide a more effective outreach effort to other Youth. http://chapters.marssociety.org/youth/